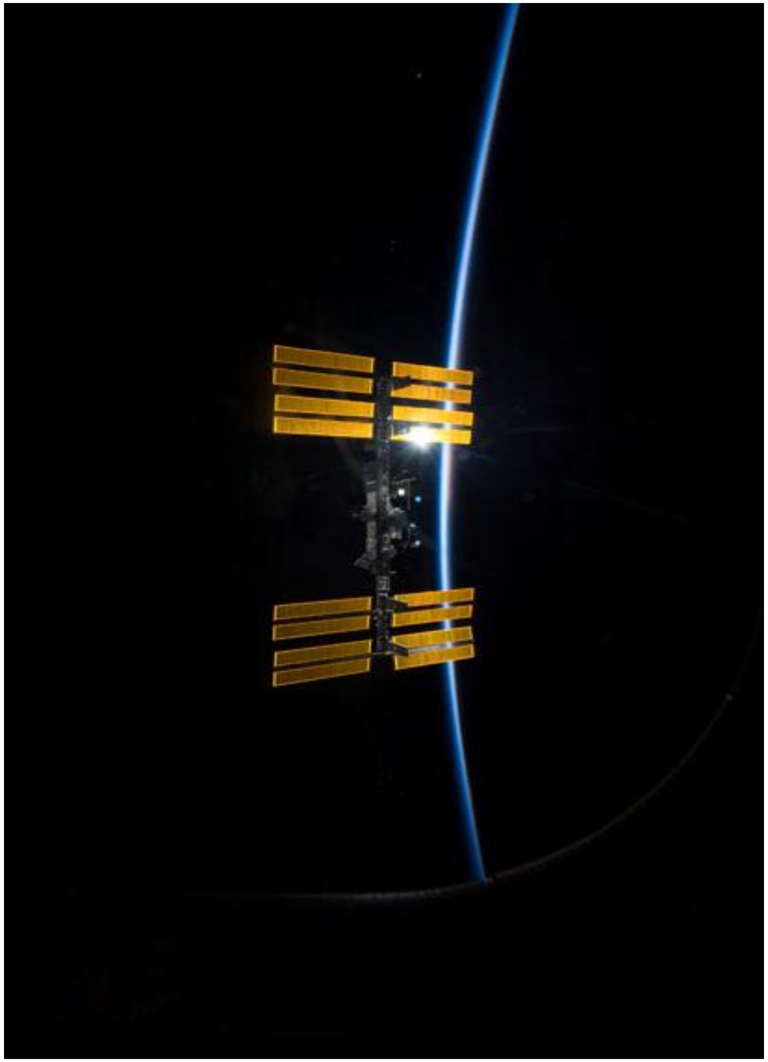


International Space Station

Cooperative Agreement with a Non-Profit Organization

Mark Uhran
Assistant Associate Administrator
International Space Station
Office of Space Operations
NASA Headquarters
Washington, DC

Contents

NPO Key Challenges

- Since Phase A (1984-88), ISS mission requirements have spanned three domains:
  - Scientific objectives – predominantly government funded, and selected through merit-based independent peer review processes.
  - Technological objectives – government/industry cost-shared to the extent possible, and selected through technical concurrence processes.
  - Economic objectives – predominantly industry funded, and selected by capital markets.

- The scope of mission requirements drove a spacecraft design that has an extraordinary full-service capability at high capacity throughput:
  - 33 static internal, pressurized payload rack sites (23 U.S.)
  - 30 static external, attached payload pallet sites (23 U.S.)
  - dynamic distributed utilities: power, thermal, vacuum, waste venting, data processing, telecommunications (76.6% U.S.)

Managing a diversified, high-yield R&D portfolio for ISS requires an "honest broker" function that operates with objectivity.
Value-based investment decision making represents "best practices".

Key Concept of Operations

Scope of ISS Utilization: ISS is capable of hosting multiple research and development (R&D) communities.

(1) NASA Utilization

NASA exploration-driven research is the primary mission objective, and includes two main components:

(1) human biomedical research necessary to extend crews further into space; and,

(2) engineering research necessary to develop and demonstrate next generation spacecraft technologies.

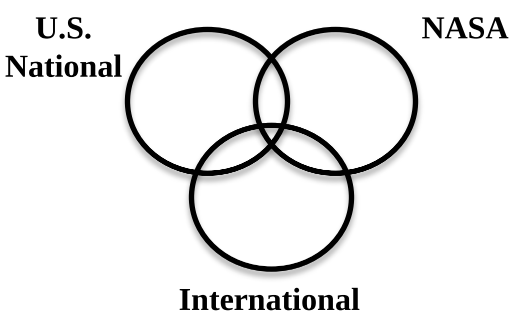
Requirements are generated, managed and funded by the responsible mission directorates/offices at NASA Headquarters (SMD, ESMD, SOMD, OCT).

(2) U.S. National Utilization

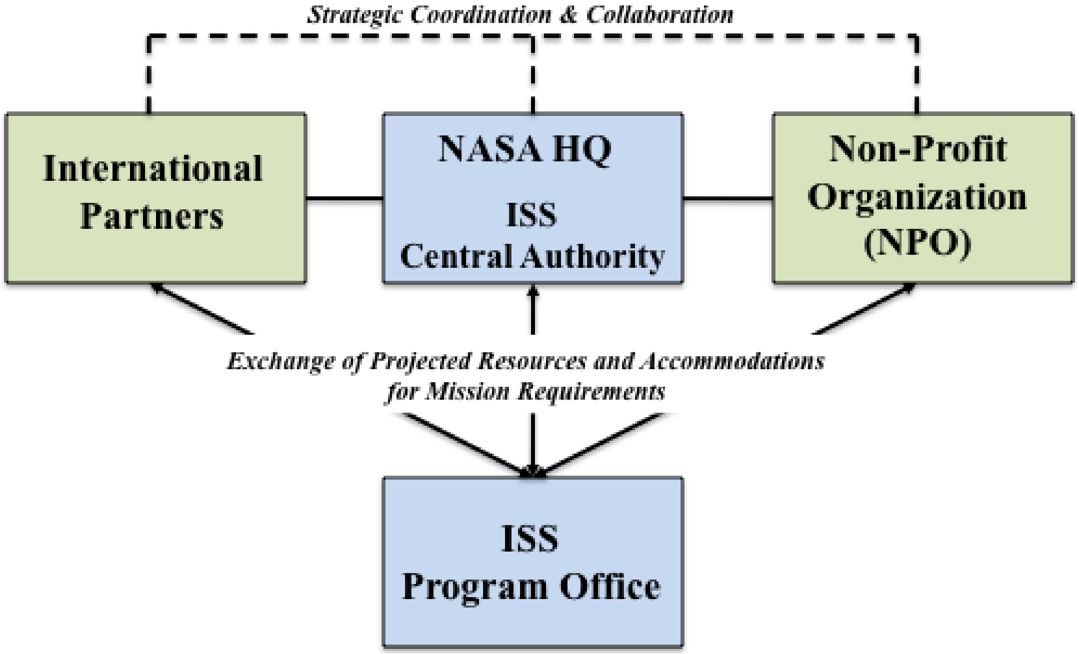
The remaining U.S. capacity is available to support U.S. national needs for basic and applied research in fields such as human health, energy and the environment. Requirements are generated, managed and funded by external organizations that hold agreements with NASA **(Scope of NPO)**.

(3) International Utilization

Canadian, European, Japanese and Russian partners each manage respective utilization programs consistent with their governing policies. Requirements are generated, managed and funded by the respective International Partner.



Leadership Approach



Level-I
(Policy & Technical Officer)

Mark Uhran
Assistant Associate Administrator, ISS
Office of Space Operations
NASA Headquarters

- **26 years experience on space station program working at the interface between developers/operators and R&D users.**

Level-II
(National Laboratory Project Officer)

Marybeth Edeen
Manager, ISS National Laboratory Project
ISS Program Payloads Office
NASA Johnson Space Center

- **23 years experience on human space flight programs working on science & technology payload physical, analytical and operations integration.**

Accountable line managers:

William Gerstenmaier, Associate Administrator, Space Operations
Michael Suffredini, Program Manager, International Space Station
Rod Jones, Manager, ISS Payloads Office

Governing Policies

- NASA Authorization Act of 2005, Section 507, National Laboratory Designation, Public Law 109-155, enacted Dec 30, 2005.

- NASA Authorization Act of 2010, Section 504, Management of the ISS National Laboratory, Public Law 111-267, enacted Oct 11, 2010.

- Federal Grant and Cooperative Agreement Act of 1977 (aka "Chiles Act"), Public Law 95-224, enacted Feb 3, 1978.
  - Section 6: Use of Cooperative Agreements

    "(1) …the principal purpose of the relationship is the transfer of anything of value to the recipient to accomplish a public purpose of support or stimulation authorized by Federal statute…"

    A share of ISS accommodations and resources will be transferred to accomplish the public purpose of stimulation directed in PL 109-155.

    "(2) …substantial involvement is anticipated between the executive agency and recipient when carrying out the activity contemplated in the agreement."

    Substantial NASA involvement remains required in order to safely and effectively integrate non government mission requirements into ISS operations.

- NPR 5800.1 Grant and Cooperative Agreement Handbook

Top-Level NPO Work Flow

(shaded area)

NASA Funding

NASA Missions
- biomedical research
- technology development
- STEM education

R&D Planning → NASA Review → Payload Development → NASA Review → Experiment Execution → NASA Review → R&D Outcomes

Apply existing NASA standards, procedures and practices for payload physical, analytical and operations integration, as well as safety certification, to all NPO missions

Non-NASA Missions
- Non-Profit Institutions
- Private Firms
- OGA Missions
- Basic S&T precursors
- STEM education

R&D Planning → Payload Development → Experiment Execution → R&D Outcomes

Non-NASA Funding
- *Other Government Agencies*
- *Institutional contributions*
- *Private investments*

NPO Primary Functions
- Establish Board of Directors for advocacy with resources network (key component)
- Stimulate non-government uses of ISS (non-profit institutions, private firms)
- Structure opportunities and program development initiatives
- Facilitate basic S&T translational research through conventional peer-reviewed process
- Match high-value R&D projects to funding sponsors for applications development
- Manage overall non-NASA S&T portfolio using value-based principles
- Conduct best-in-class communications on benefits and outcomes

Four Risks Identified

1. Organizational conflict of interest
2. NASA-NPO working relationship
3. Requirements integration and prioritization
4. Cargo transportation availability

1. Organizational Conflicts of Interest

- Two functions of the NPO for ISS will involve the selection of users and the prioritization to use ISS.
- Objectivity is critical for the NPO to be successful.
- Risk Mitigation:
  - Limit offerors to nonprofit entities since a for profit entity is more likely to have a financial interest in an end user. Use of nonprofits creates better appearance of objectivity.
  - Prohibit offerors from being users of ISS
    - Decisions about selection process may be questioned if NPO is a user of ISS.
    - Decisions about prioritization may be questioned if NPO is a user of the ISS.
  - Prohibit offerors from holding financial interests in user entities.

2. NASA-NPO Working Relationship

- Cooperative Agreement is applicable when, "*substantial involvement is anticipated between the executive agency and recipient when carrying out the activity".*

- For this agreement, substantial involvement is anticipated in two areas:

  (1) NASA headquarters must implement Federal policy aspects effecting the share of U.S. resources and accommodations to be made available to non-government users via NPO.

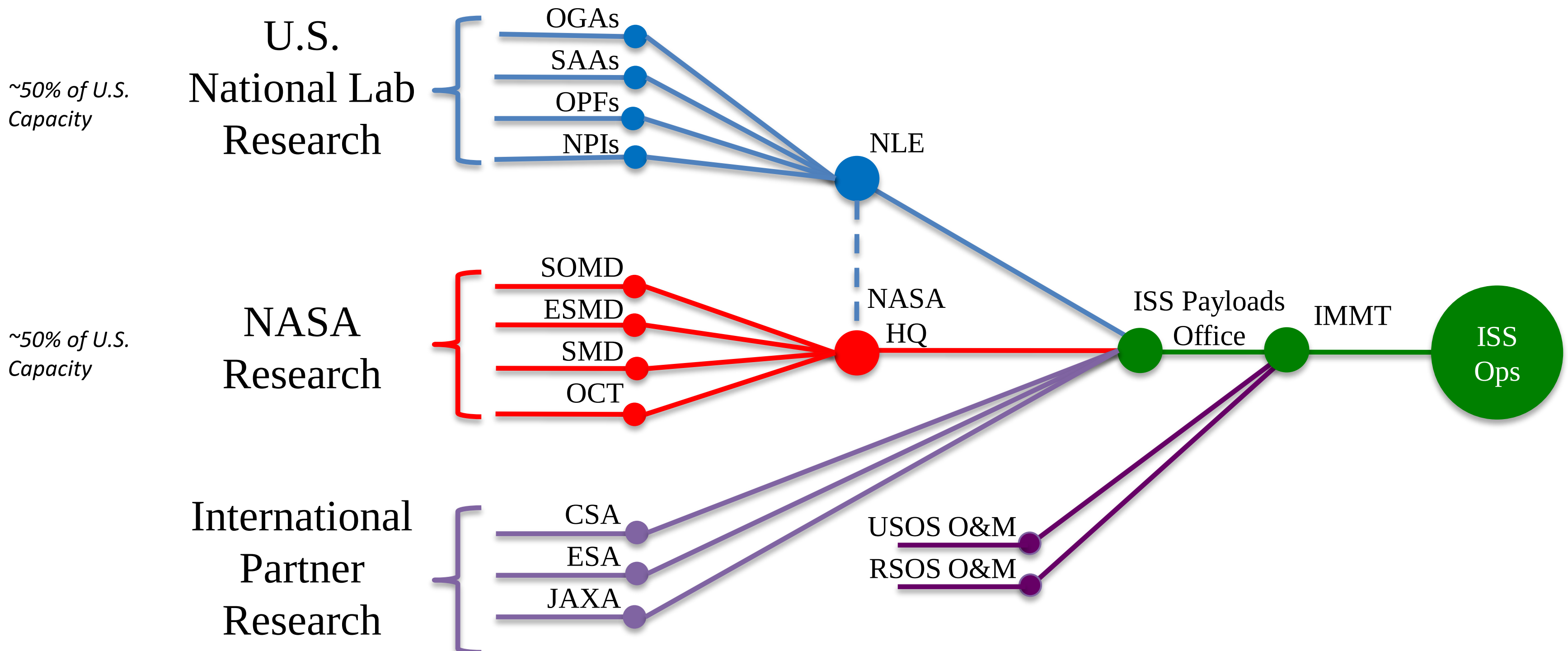
  Risk Mitigation: Within SOMD, an ISS Central Management Authority should be held accountable to Administrator for allocation of ISS resources and accommodations among NASA and non-NASA users.

  (2) JSC ISS Program Office must implement standing procedures for payload physical, analytical and operations integration consistent with past practices to ensure clear assignment of responsibilities and safe operations.

  Risk Mitigation: Within JSC ISSPO a dedicated ISS National Laboratory Project was established in Feb, 2009, and staffed to support this objective.

3. Requirements Integration & Prioritization

- **An orderly process is essential for integrating mission requirements across competing organizations.**
- **Risk Mitigation: queuing models represent "best practice" (illustrated below). Each node in queue responsible for prioritization within its scope.**



CSA – Canadian Space Agency	OCT – Office of the Chief Technologist (NASA)
ESA – European Space Agency	OGA – Other Government Agency (U.S.)
ESMD – Exploration System Mission Directorate (NASA)	OPF -- Other Private Firm (U.S.)
IMMT – ISS Mission Management Team	RSOS – Russian Segment Operating System
JAXA – Japan Aerospace Exploration Agency	SAA -- Space Act Agreement (NASA)
NLE – National Lab Entity (U.S.)	SMD – Science Mission Directorate (NASA)
NPI – Non Profit Institutions (U.S.)	SOMD – Space Operations Mission Directorate (NASA)
O&M – Operations and Maintenance	USOS – U.S. Segment Operating System

4. Cargo Transportation Availability

- **ATV, HTV and Progress required predominately for O&M of ISS and NASA mission research**
  - U.S. purchase of Progress services only planned through 2011

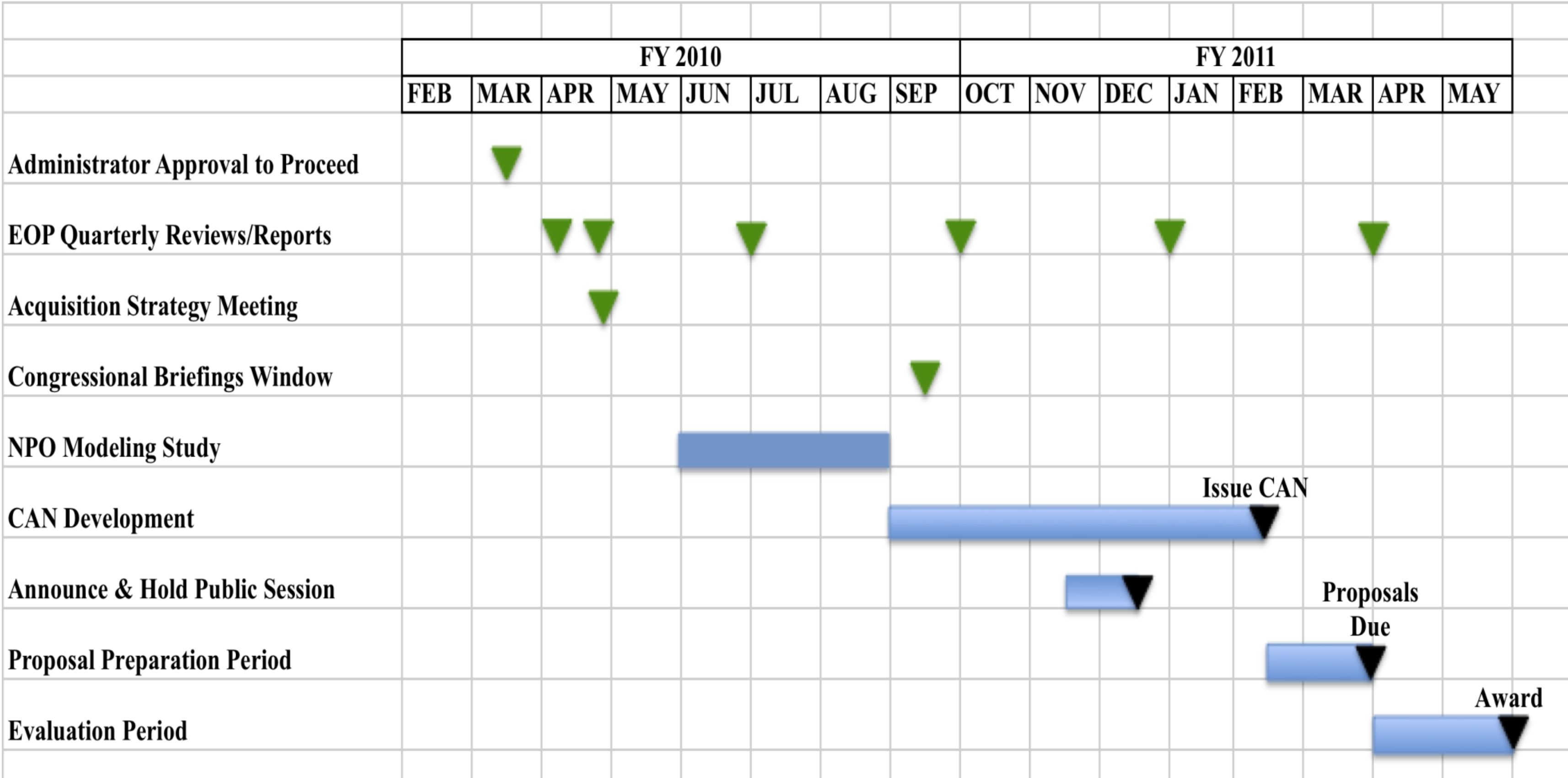
- **Commercial Resupply Service (CRS) flights required to provide sufficient up/down mass for National Lab users**

COTS
- **SpaceX**
  - Demo 1 — Dec 15, 2010
  - Demo 2 — Jun 2011
  - Demo 3 — Sep 2011
    - Berthing to ISS
- **OSC**
  - Demo — Nov 2011
    - Berthing to ISS

CRS
- **SpaceX**
  - CRSX 1 — Dec 7, 2011
  - CRSX 2 — Apr 2012
  - CRSX 3 — May-Jun 2012
- **OSC**
  - CRSO 1 — Jun-Mar 2012
  - CRSO 2 — Jul-Sep 2012

CRS flights are critical to success of National Lab.

Schedule


FY 2010
FY 2011
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
Administrator Approval to Proceed
EOP Quarterly Reviews/Reports
Acquisition Strategy Meeting
Congressional Briefings Window
NPO Modeling Study
CAN Development
Issue CAN
Announce & Hold Public Session
Proposals Due
Proposal Preparation Period
Award
Evaluation Period

Reference Model
for the
International Space Station U.S. National Laboratory

PROORBIS®
MANAGEMENT INNOVATIONS

Overview

Prepared By: ProOrbis, LLC
Commissioned by NASA

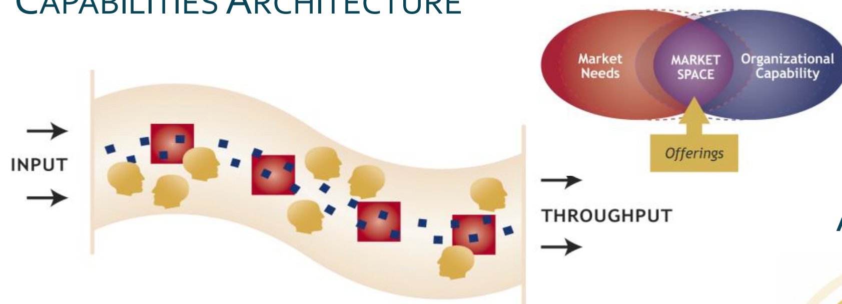
International Space Station
U.S. NATIONAL LABORATORY
Advancing Science in Space

ProOrbis® Framework – Start to Finish

ISS U.S. National Laboratory

Positioning

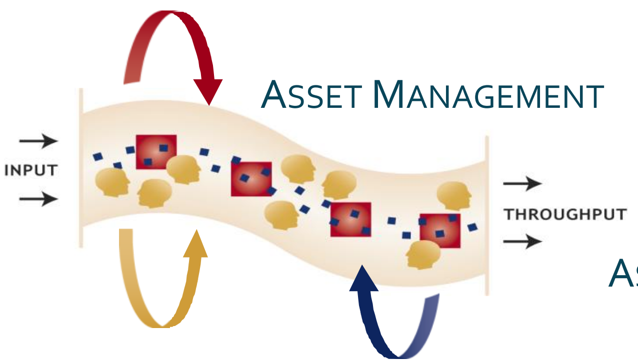
Capabilities Architecture



- Classification
- Integration
- Link to Value

Project Approach

Asset Management



Human Capital Asset Management

Dashboards

Study Design Approach

We have conducted a study and formulated recommendations for a management plan for the ISS National Laboratory Enterprise to take advantage of the non-NASA uses of ISS:

- Organizational Goal to design and enterprise that would maximize the value to the American people of the investments made in the ISS
- Approach:
  1) Identify the valuable uses of the unique ISS environment (tangible and intangible)
  2) Analyze the current capabilities of the ISS and its supply chain (payload development, transportation, labs, funding, etc)
  3) Identify the missing capabilities that are preventing value creating utilization
  4) Design the optimal enterprise to deliver those capabilities

Competitive Advantages of ISS

ISS U.S. National Laboratory

Competitive Advantages

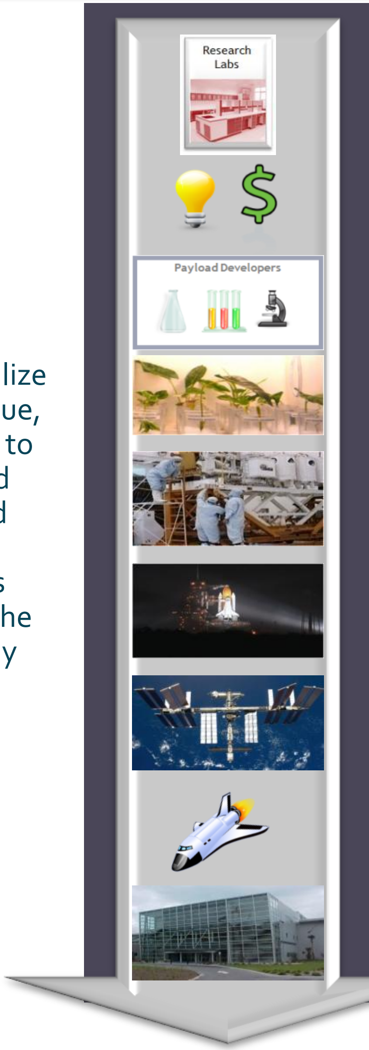
Microgravity
- No Sedimentation
- Lack of Gravity Driven Convection
- Decreased Hydrodynamic Shear
- No hydrostatic pressure gradient
- Mass Transfer is limited to the rate of diffusion

Extreme Conditions
- Extreme temperatures of hot & cold
- Atomic Oxygen
- Intermediate Radiation levels
- Meteor showers
- Ultra-vacuum environment

Low Earth Orbit
- ISS orbits from 199 miles to 350 km above the Earth surface.
- Orbital path over 90% of the Earth's population

ISS Supply Chain

In order to realize maximum value, must be able to identify and understand capacity constraints throughout the entire supply chain



Step	Supply Chain System	Description
1	Research Labs	Initial research to formulate project ideas
2	Projects and Funding	New ideas and funding for the innovative projects
3	Payload Developers	Requirements for flight hardware including design, development, testing and certification (varies by new or existing hardware needs)
4	Processing Laboratory	Pre-Flight operations (Data Analysis)
5	Payload Integrators	Brings together individual experiments, support equipment, and software into a single payload in which all interfaces and compatible and whose operation has been fully checked out
6	Transportation	Up-mass
7	International Space Station	Research laboratory
8	Transportation	Down-mass
9	Processing Laboratory	Post Flight operations (Data Analysis)

NPO Purpose and Features

ISS U.S. National Laboratory

"Advancing Science in Space"

- Confidence and stability to investors and researchers to make the investments in moving to this new research platform

To Maximize the Value to the U.S of Investments Made in ISS

- By creating an enterprise that builds a community of interest in this type of research, ISS becomes a stepping stone to future space-based assets which bridges a major concern about the life span of ISS

Longer Term-Focus: Advancing Science in Space

World-class, established, responsive, Accessible, innovative

Impartial, Unconflicted

Creating a Community of Interest

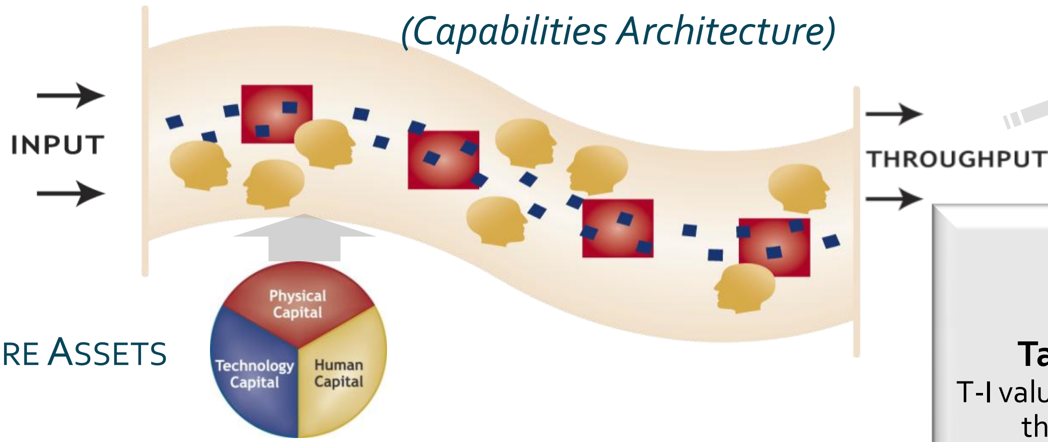
Issues	Awareness	Basic/Applied Science Connection	Funded Research Projects	Funded STEM Projects	Priority	Ease of Use	Space Research Expertise
Key "Missing" Capabilities	Package and Message and Publish	Setting Research Pathways	Matching Projects and Funding	STEM Coordination	Impartial, Value-Based Prioritization	PI Support	Advancing Academic Interest & Integrity

Tangible vs. Intangible Value

ISS U.S. National Laboratory

Main Transform

(Capabilities Architecture)



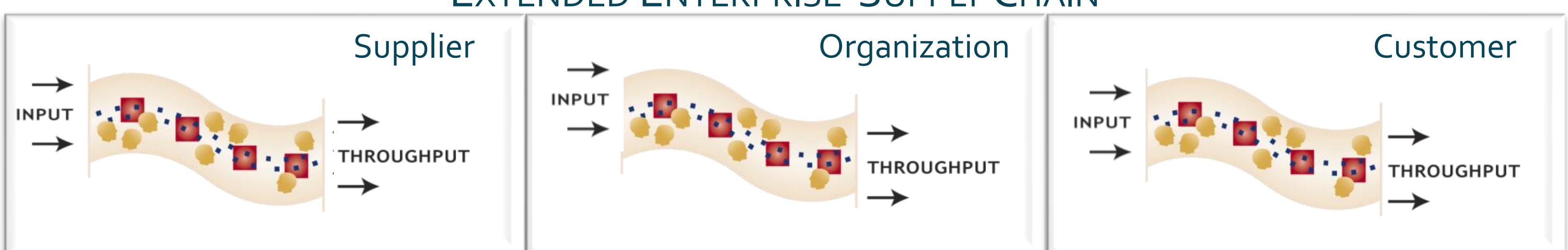
Core Assets

Tangible Value
T-I value that comes to and through the NPO

Intangible Value
Value for the American citizenry derived from activities on ISS

Tangible value is the direct value of the organization – intangible value is with respect to the interest of the shareholders

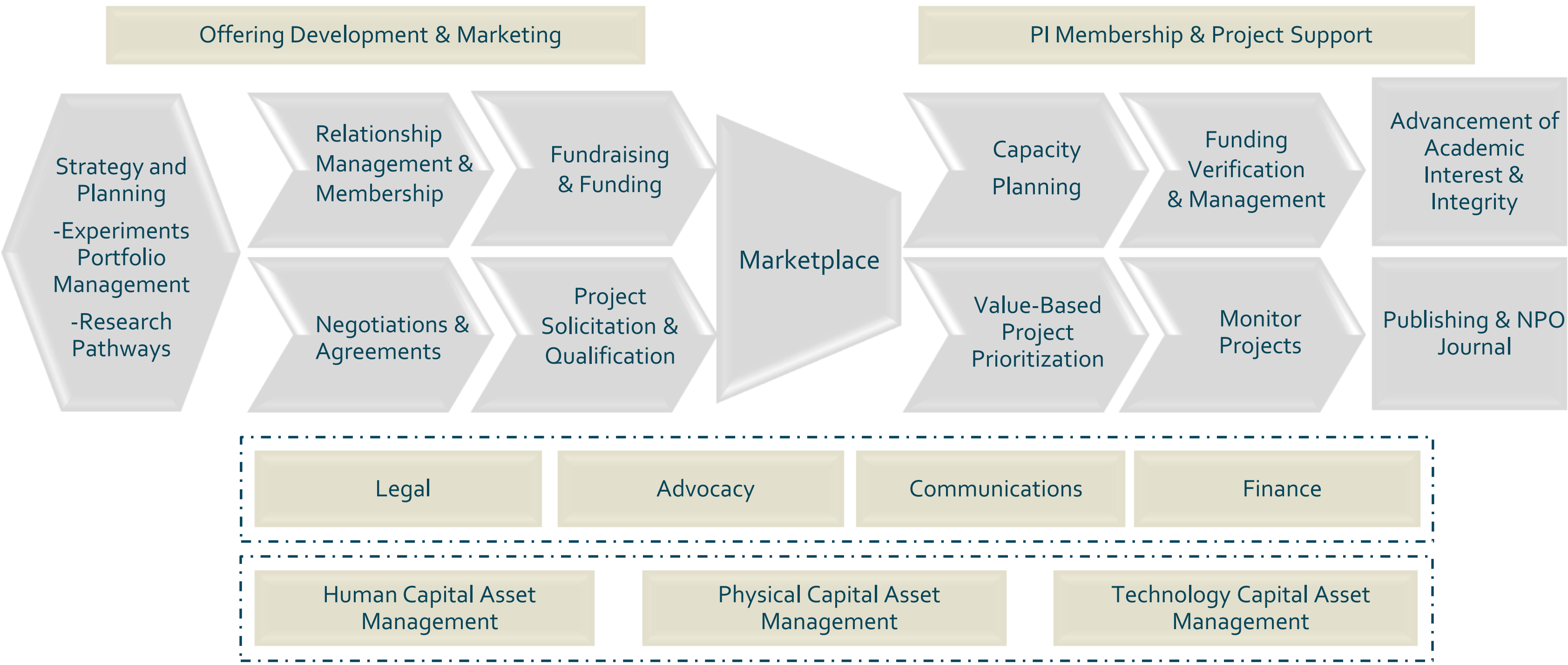
Extended Enterprise-Supply Chain



Capability Overview

ISS U.S. National Laboratory

Capability Architecture



NPO Legal Structure Recommendation

ISS U.S. NATIONAL LABORATORY

A 501(c)(3) Entity supports the requirements necessary to execute the NPO's mission. Key factors include the ability to:

- Be designed to support a special and uniquely purposed enterprise
- Raise and receive funds from public and private entities and use proceeds for education and research
- Support membership models
- Accommodates a vast array of interests (mission oriented and private)
- Be set-up in a timely fashion
- Be relatively flexible to change to a different legal entity if needed in the future
- Be managed by appropriate rules for a mission-oriented organization

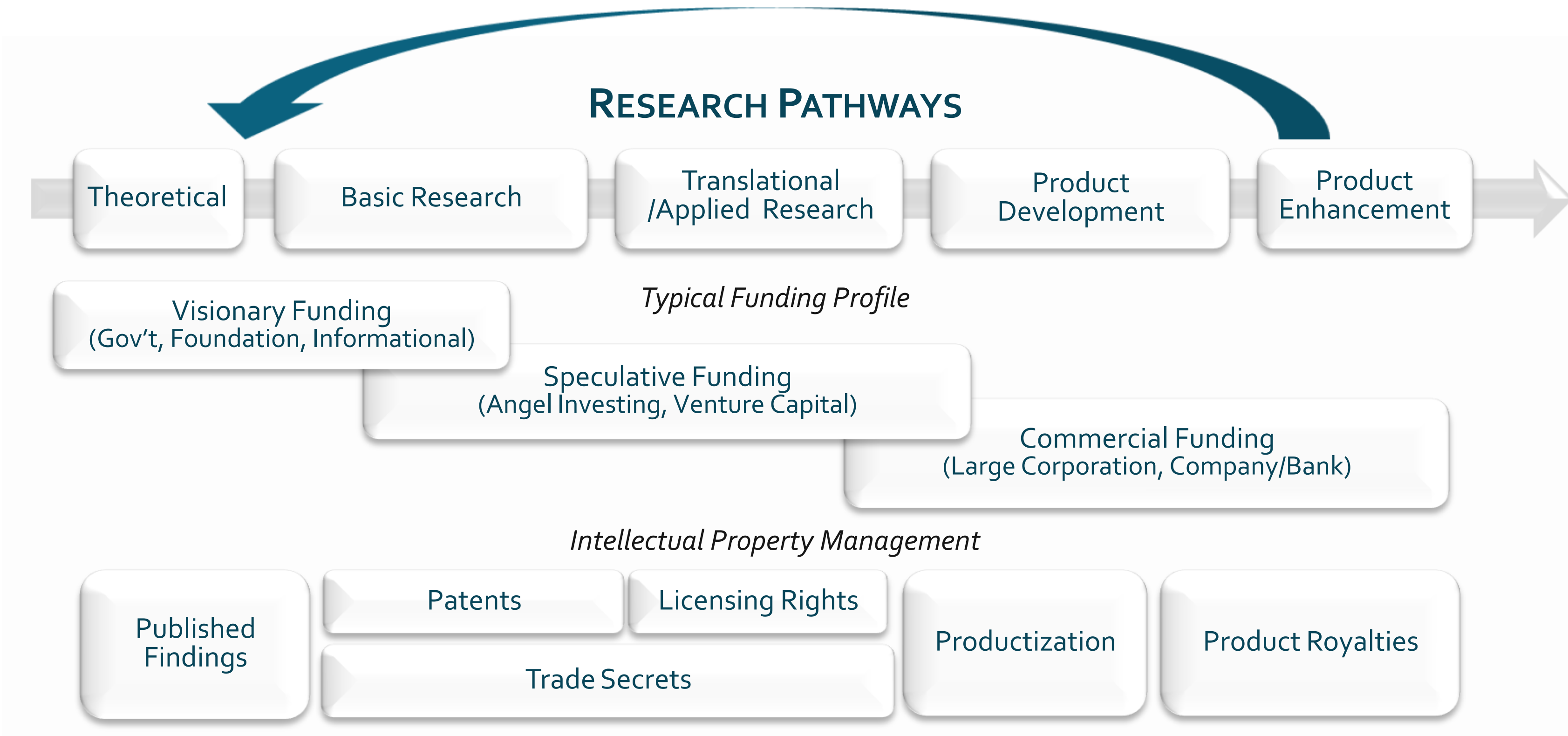
Key Issues in Start up:

- Delegation of Authority
- Financial Assistance
- Speed and Depreciation
- Attracting a National Caliber Board of Directors
- The Founding Board

The tight fit of this form enables management and control for the least amount of additional cost.

Research Pathway – Conceptual Model

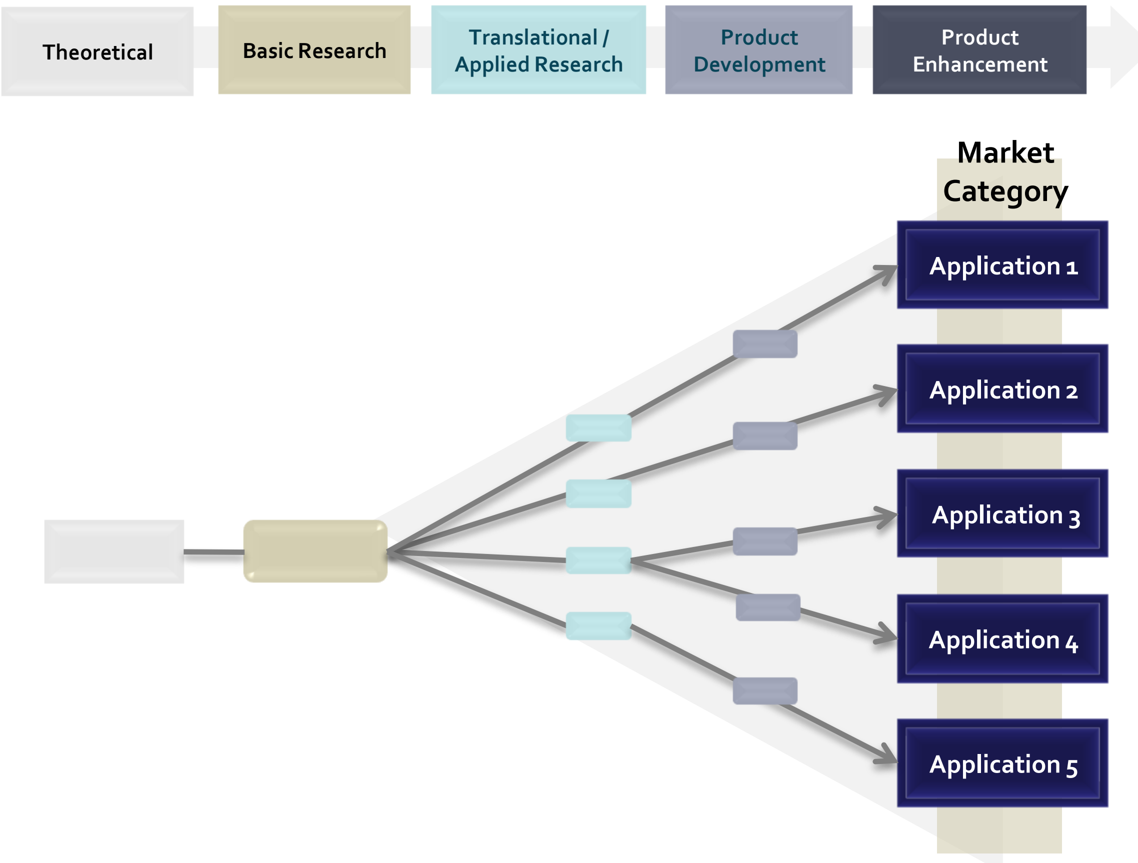
ISS U.S. National Laboratory



Research Pathway – Opportunities

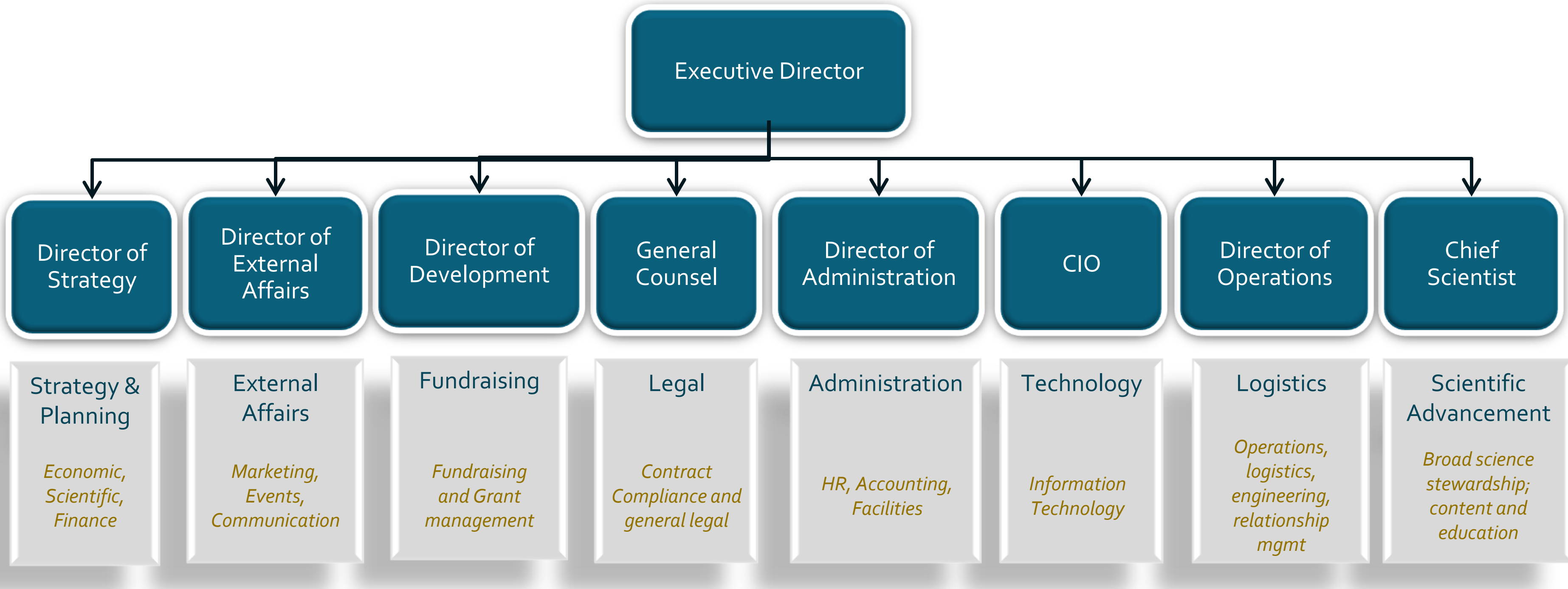
ISS U.S. NATIONAL LABORATORY

Research pathways are the key to valuing fundamental science. They put R&D projects in their "value context" and help to establish what we know, what we don't know and what it might be worth to know it. In this way, they provide the strategic frame for both building a more robust underpinning for applied research and the relevancy for basic research. Articulating what value could be derived from a discovery and formulating a pathway to that value creates the opportunity for more targeted investment that shortening the cycle time between discovery and practical application. Improving national returns on R&D investments and articulating the value created could lead to dramatic increases in funding for basic research and more efficient use of funds available.



Organization

ISS U.S. National Laboratory



The design of the organization is very lean and specifically purposed which is reflected in the budget for operations. Requirements for technology assets and physical facilities are included in the full report. Again, specially purposed organizations can be designed to execute sets of capabilities very efficiently. Repurposing an existing organization introduces risks of non-value added overhead cost, conflicted interests, mismatched assets (human, technology or physical capital) and ingrained problematic cultural patterns which may seriously impair performance.

Creating accountability for performance requires a combination of a clearly articulated objective and purpose, the capabilities to execute and measures to demonstrate progress.

Board of Directors

ISS U.S. National Laboratory

Managing Members

Designees of the Chairman and Ranking Members of :

House

Committee on Science and Technology

Senate

Committee on Commerce, Science and Transportation

NASA

Administrator

9 Appointed Members

•Team – Diverse team of senior executives spanning the breadth of management and advocacy experience and influence needed.

Provide advocacy, fundraising and management advice

Scientific Members

Designees of the top ranking scientists of:

NIST

DARPA

NIH

DOE

NSF

DOA

6 Appointed Members

•Team– Leading academic and industrial team from the leading fields of Biology, Chemistry, and Physics

Lead the establishment of research pathways, project selection, advancement of academic interest and integrity

Ex Officio

Voting Members

One of the needs for a de novo organization is the ability to obtain a Board of Directors with the right level national stature, skill mix, and accountability and an organization with the exact right mix of assets The BOD is critical to success, especially to a start-up. The model has taken great care in articulating the selection process for the initial BOD to ensure that it will attract the best talent.

Initial Board Selection

- Ex Officio Board
  - Members are designees of each Office
- Candidates for Appointed Board Members
  - List of Qualified Candidates developed by NASA Administrator in consultation with OSTP
- Appointed Board
  - "Scientific" Board members -6 individuals consisting of representatives from:
    - Biology field (academia and industrial research);
    - Engineering
    - General chemistry; and
    - Physics field (academia and industrial research)
  - "Managing" Board members – 9 individuals
    - Optimal mix of candidates covering the breadth of skills and experience required for advocacy, advice, fundraising

OSTP & NASA Administrator

List of Qualified Candidates

Ex-Officio Members

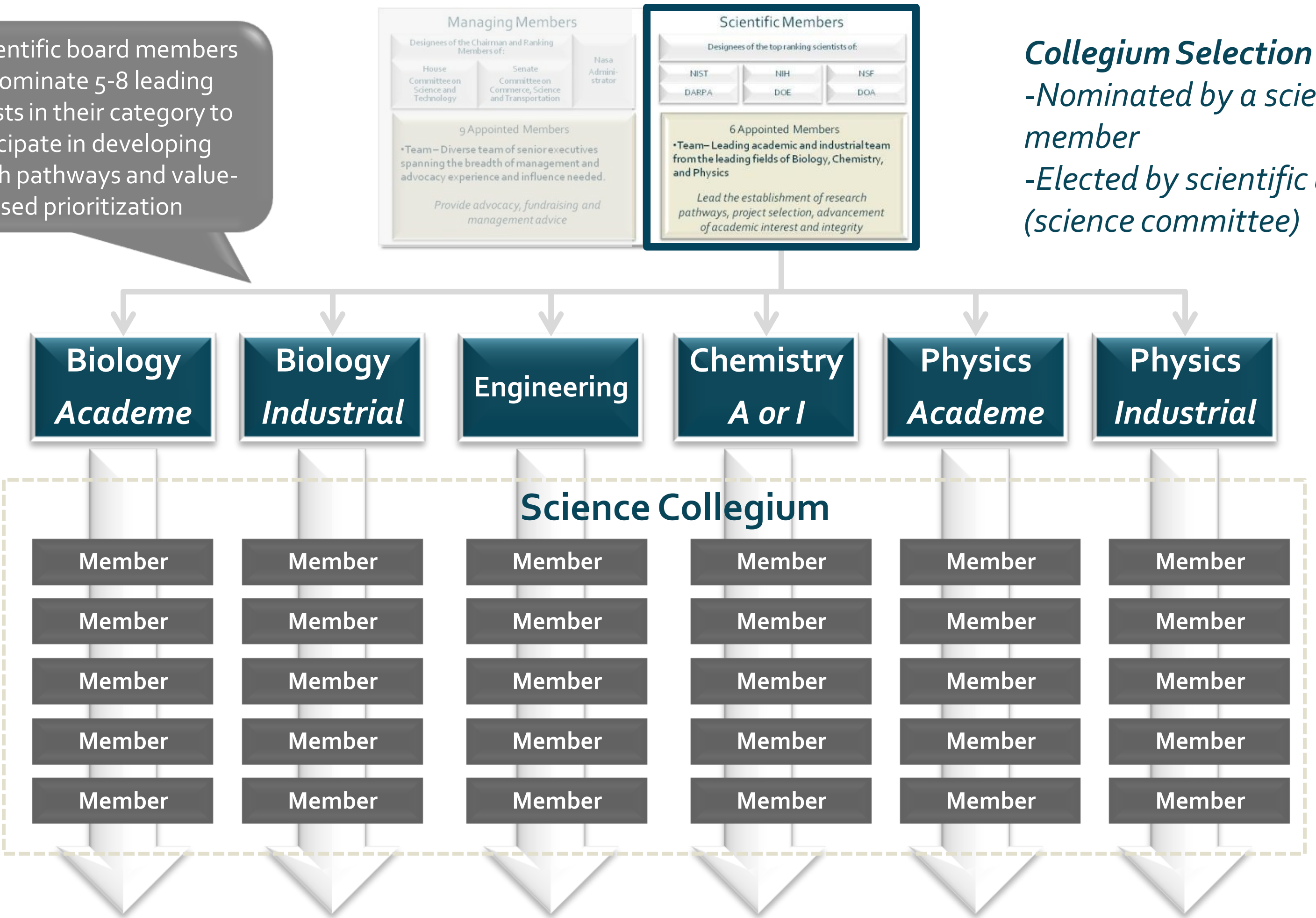
Select and appoint a qualified team

9 Managing Appointed Members

6 Scientific Appointed Members

Science Collegium

The scientific board members will nominate 5-8 leading scientists in their category to participate in developing research pathways and value-based prioritization



Collegium Selection

-Nominated by a scientific board member

-Elected by scientific board members (science committee)

NPO Dashboard of Performance Measures

ISS U.S. National Laboratory

Type	Measures Requirement	Calculation Samples
Overall Value– Intangible (U.S. Economic Interest, Education , Security, Life on Earth or Space , Leadership in Space)	Dimensionalize the net value of research or educations created as a result of ISS-NL projects	• Value to American people generated from the unique activities of the NPO minus amortized investment of the ISS-NL stakeholders (Net Value) • Net Value of contribution ISS technology makes to products and services revenue and related tax revenue from the profits • Net Value of the improvement to human capital stocks
Positioning	Performance against the functioning objectives of the enterprise	• Performance against the NPO BOD, congressional mandates and NASA requirements (such as the Ratio of Utilization % of the ISS-NL allocation to NPO investment) • Tangible Value to Investment Ratio • Net Value • Growth rate in net Value
Strategic Objectives	Indicators of progress toward key strategic goals	• Ratio of appropriated to NPO-generated funding • Ratio of NASA to NPO Educational Funds • Projected Value of Research Pathways in Development
Portfolio Objectives	The value created by the investment in NPO resources. Operational Efficiency	• Ratio of total ISS-NL research funding to NPO Investment • Ratio of total ISS-NL research value created to NPO Investment • Ratio of education programs funded to NPO investment